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Artificially Low Interest Rates as Export Promotion Policy*

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Abstract

We reconsider the effects of an artificially low interest rate policy, which was typically implemented in Japan until the early 1970s. This policy is defined as a combination of the interest rate ceiling and rationing rules that assign a priority-lending status to export sectors; it should be distinguished from the simple interest rate ceiling. We reveal that the simple interest rate ceiling leads to credit rationing and does not increase national income, while the artificially low interest rate works as an export-promotion policy; that is, it increases exports, national income, and welfare.

JEL Classifications: F13; G28; O25
Keywords: Artificially low interest rate policy; Interest rate ceiling; Export-promotion policy; Credit rationing

1 Introduction

The policy of *Interest rate ceilings* was widely observed in many developing and middle-developed countries, particularly during the 1950s and 1960s. Under this policy, governments enforced low interest rates by establishing a ceiling for deposit and/or lending interest rates through legislation and intervention. The purpose of an interest rate ceiling was to create an environment in which private banks can finance domestic firms at low interest

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rates. It was believed that these firms promote capital accumulation, leading to economic development of the country.

However, interest rate ceilings give rise to excess demand in financial markets – a phenomenon *credit rationing*. This creates a distortion in the financial markets and a decrease in the funds available for capital accumulation. McKinnon (1973) and Shaw (1973) assert that interest rate ceilings are unfavorable because they create *financial repression*,[1] and conclude that the distortion in financial prices reduces the real growth rate and inhibits *financial deepening*. Therefore, they suggest that governments should liberalize their financial markets. Their criticisms are persuasive, and many economists agree with their arguments.

Although a trend in financial liberalization was observed, interest rate ceilings were implemented in several countries. In particular, from the 1950s to the early 1970s, the Japanese government created a financial system based on interest rate ceilings. During this period, financial transactions with foreign countries were strictly regulated under the *Foreign Exchange and Foreign Trade Control Law* and the *Foreign Capital Law*. The Japanese government also controlled most interest rates, instituted various regulations on domestic financial transactions, and intervened to concentrate the lending of funds to particular manufacturing sectors. Figure 1 illustrates the share of loans provided by the Development Bank of Japan, which is a special bank for supplying long-term funds, from 1956 to 1971. The shares are classified by some policy aims of the Development Bank of Japan. The share of "Improvement of industrial infrastructure," whose main items were maritime industry, electricity, coal, oil, and wharf, occupied most of the lending in the 1950s, while it decreased during the 1960s. On the other hand, the share of "Improvement of international competitiveness and technological development," whose main items were textile, iron and steel, automobile, and chemicals, had increased in the 1960s. According to Hidaka (2009a), the Development Bank of Japan set a special lending rate, which is the lower than its basic lending interest rate. The implementation of the special lending rate increased in industries in the "Improvement of International Competitiveness and Technological Development" toward the end of the 1960s.

Figure 2 illustrates the amount of exports in these industries from 1956 to 1972. It shows that the exports of all these industries sharply increased since the end of 1960s. This period is coincident with that when the amount

[1] Giovannini and de Melo (1993) define *financial repression* as a combination of controls on international capital flows with restrictions on domestic interest rates.

of loans and appliance of the special interest rate had increased in these industries in order to promote their competitiveness. Although the share in policy-based finance was not large, we can deduce that loans successfully lead to increased productivity and high growth in these industries.

On the basis of the criticism by McKinnon and Shaw, we may infer that the interest rate ceiling is harmful. However, the period from the 1960s to the early 1970s is often referred to as "the era of rapid economic growth." The Japanese economy achieved a real economic growth rate of more than 10 percent per year. In particular, exports of manufactured products grew rapidly. This might imply that the international competitiveness of Japanese manufacturing industries improved in this period.

Demetriades and Luintel (2001) suggest that the government of South Korea had adopted this policy from the mid-1960s to the mid-1990s. Priority sectors, which were mainly export-oriented industries, received inexpensive bank credit. They conclude that this financial restraint has a positive and significant effect on financial development in South Korea.

Then, is the interest rate ceiling absolutely harmful? We consider the possibility that it is effective as an export-promoting policy. To prove this, we set up a small country model in an overlapping-generations setting and investigate the effects of the interest rate ceiling on exports, national income, and welfare. The interest rate ceiling is a regulation that keeps the interest rate of lending funds less or equal to the ceiling level. Decreasing the lending interest rate by setting a ceiling leads to an increase in fund demand from the exportable manufacturing sector. However, since the savings of households do not increase, this sector faces credit rationing. Credit rationing is a new resource constraint, which cannot expand its production. As a result, the simple interest rate ceiling does not work as an export-promoting policy.

Credit rationing is a crucial reason that the interest rate ceiling does not work. Thus, we provide an alternative option for the interest rate ceiling to prevent the rise of credit rationing. We define an *artificially low interest rate* as a policy package[2] comprising the interest rate ceiling and a rationing rule that assigns a priority-lending status to a particular sector. The rationing rule provides sufficient funds to the export sector at a low interest rate, and the sector increases its exports. At the same time, other sectors in this country struggle owing to a dearth of funds. We show, however, that if the former effect sufficiently raises national income, national welfare is improved

[2]Teranishi (1982) and Horiuchi (1984) point out that the artificially low interest rate in Japan refers not only to a policy of keeping the interest rate low, *i.e.*, interest rate ceiling, but also to other systematic financial policies such as interventions to the financial flow.

by the artificially low interest rate. In sum, we conclude that the simple interest rate ceiling is not effective, while the artificially low interest rate is effective as an export-promoting policy and it increases national income and welfare.

Several studies have positively evaluated interest rate ceiling and criticized the literature on financial repression.[3] Considerable empirical evidence shows that financial restraints, including interest rate restrictions, have a positive effect on financial development (*e.g.*, Demetriades and Luintel 2001; Arestis et al. 2002; Arestis et al. 2003). Moreover, Hellmann et al. (1996, 1997) discuss the possibility that interest rate ceilings reduce the problem of asymmetric information in financial transactions and promote economic development. Demetriades and Devereux (2000) study a case wherein the restriction of lending rate increases the long-run equilibrium aggregate capital stock. Daitoh (2003) explores the relationship between interest rate ceilings and unemployment in developing countries. While our paper also evaluates interest rate ceiling positively, its approach is quite different. The above studies are based on traditional economic and financial development. In contrast, this paper focuses on another aspect of the interest rate ceiling; that is, it sheds light on the effects of interest rate ceiling on exports.

The rest of this paper is organized as follows. Section 2 provides the basic model and investigates the effect of the simple interest rate ceiling. Section 3 extends the model and analyzes the effect of the artificially low interest rate. Section 4 considers the reasonability of our assumptions and discusses the robustness of our results. Finally, section 5 provides some concluding remarks.

2 Interest rate ceiling

2.1 The model

There are two economic regions: a middle-developed small country (*home*) and the rest of the world (*foreign*). The exchange rate is fixed at unity. The home country has a household sector and a financial intermediate sector, and two production sectors: primary and manufacturing. We assume that there are two factors of production: labor and capital. The rate of capital depreciation is 100%. Capital is supplied through the investment of household savings in the financial intermediate sector. While the manufacturing

[3] Fry (1995) indicates the relationship between financial liberalization and financial regulation. Arestis and Demetriades (1997) provide an overview on empirical literature in the field.

sectors use both labor and capital in production, the primary sector only uses labor. The primary good is sold in a perfectly competitive world market with no trade costs. We assume that one unit of the primary good is produced from one unit of labor by a constant return to scale technology, and we regard the primary good as numeraire. Then, wage rate equals one in equilibrium.[4]

In the economy, there are N types of manufacturing goods indexed by n ($n = 1, \cdots, N$) that are sold in integrated world markets. We assume that the home small country has only one manufacturing firm in the first type of manufacturing sector ($n = 1$), and call it firm h. This firm sells its products to an integrated world market that is characterized by a Cournot duopoly. The rival firm in the rest of the world is called firm f.

The interest rate ceiling policy is a regulation on the financial intermediate sector. By setting an upper-limit on the lending interest rate, the government in the home country keeps the lending interest rate down for firm h. In the following subsections, we provide further details of our model.

2.1.1 Households

We consider a household sector with overlapping generations. The population of each generation is constant and normalized to one; there is no population growth. We assume that households are internationally immobile, and live for two periods: young and old. Time is denoted by superscript $t = 0, 1, \cdots$. Each household inelastically supplies one unit of labor in their young period only. For simplicity, we assume that the household does not consume in the young period and deposits all wage income in the financial intermediate sector for consumption in the old period. Since the wage is kept at one from the assumptions of the primary sector, the value of total deposits in the home country is one. In period $t + 1$, the old household receives the principal and interest i^t, which is the gross interest rate on deposits. Moreover, the household inherits shares in firm h in the manufacturing sector from parents at the end of the young period. The dividends from shares equal firm h's profit π_h. Therefore, an old household's income in period $t + 1$, I^{t+1}, is

$$I^{t+1} = i^t + \pi_h^{t+1}. \tag{1}$$

The preferences of a household in generation t are given by

$$U^t = \eta_X \log X^{t+1} + \eta_y \log y^{t+1}, \tag{2}$$

[4]The main purpose for considering a primary sector is to set the wage to one and to simplify the labor market. See Dixit and Grossman (1986).

where each η_j $(j = X, y)$ is a positive constant and $\eta_X + \eta_y = 1$, y is the consumption of primary goods, and $X = X(x_1, \cdots, x_N)$ represents the consumption of each manufacturing good $x_n (n = 1, \cdots, N)$. Since we only focus on the stationary equilibrium, we omit the superscript t in the following analysis.

2.1.2 The manufacturing sector

There are only two firms, firm h in the home country and firm f in the rest of the world, capable of producing the manufacturing good with index $n = 1$. These firms engage in Cournot competition in the integrated world market. We omit the subscript of x_1 when considering only the $n = 1$ manufacturing sector in the following. Each firm has a Cobb-Douglas production function:

$$x = ak^{\alpha} l^{1-\alpha}, \tag{3}$$

where k and l are the capital and labor inputs respectively, a is a positive constant, and $\alpha \in (0, 1)$. From (3), we obtain the capital demand function k_h:

$$k_h = a^{-1}\alpha^{1-\alpha}(1-\alpha)^{-(1-\alpha)} r^{-(1-\alpha)} x_h, \tag{4}$$

where r is the lending interest rate for the manufacturing sector in the home country. Note that the wage rate is one. The inverse demand for products in the world market is given by

$$P_x = P_x(x_h + x_f), \text{with } P_x' < 0. \tag{5}$$

Evidently, the demand depends on the total world income. However, from the small country assumption, the policy of the home country does not affect world income. Thus, we consider world income as a constant.

2.1.3 The financial intermediate sector

The financial intermediate sector comprises several identical banks that engage in Bertrand competition. Here, we do not explicitly consider the cost function of banks. Regardless of the cost function considered, each bank receives zero profit because of Bertrand competition among identical banks.[5]

[5]For analytical simplicity, we consider Bertrand competition among identical banks without explicit cost function. Section 4 discusses the cases where we explicitly consider the cost function of banks and where banks have positive profit margins. However, in both the cases, our upcoming results qualitatively hold.

Note that since the government controls the lending interest rate, firm h does not hold monopolistic power in the lending market.

The interest rate in the rest of the world, R, is constant because the home country is small. If the home country can trade funds with the rest of the world with negligible transaction costs, the deposit and lending rates must equal the world interest rate, *i.e.*, $i = r = R$, because of the small country assumption. Here, we assume that the government enforces a restriction on foreign exchange. Suppose that a transaction cost per unit of funds, τ, is incurred by agents who transact funds overseas. This transaction cost τ includes costs of administration procedures for the transaction of foreign exchange and foreign investment as well as communication and agency costs. The government can increase this transaction cost by setting various regulations on foreign exchange.[6] Therefore, we have the interval of these interest rates in equilibrium:

$$i, r \in [\max\{R - \tau, 1\}, R + \tau], \tag{6}$$

where the lower limit is at least one because we consider a gross interest rate. This interval contracts with a decrease in τ. Note that this restriction not only prevents capital flight associated with a low interest rate but also prevents the inflow of foreign funds.

Next, we consider the level of the interest rate ceiling in the lending market for the manufacturing sector, $\bar{r}$. The interest rate ceiling prevents banks from lending funds to the manufacturing sector at an interest rate higher than $\bar{r}$. If $\bar{r} > r^*$, where the asterisk is used to represent the laissez-faire economy, this regulation is not effective. If $1 \leq \bar{r} < R - \tau$, this policy may lead to capital flight. Thus, we find the range of $\bar{r}$ for which the interest rate ceiling binds:

$$\bar{r} \in [\max\{R - \tau, 1\}, r^*). \tag{7}$$

International capital flows are blocked by the restriction on foreign exchange. Because the savings of households equals to one and the capital demand function is downward sloping from (4), this policy leads to excess demand in the lending market. Thus, the available capital for firm h is fixed as one, *i.e.*,

$$\bar{k_h} = 1, \tag{8}$$

where the upper-bar is used to denote that an interest rate ceiling has been implemented. In this section, the deposit interest rate equals the lending

[6] In Japan between the 1950s and the early 1980s, financial transactions with foreign countries were strictly regulated under the *Foreign Exchange and Foreign Trade Control Law* and the *Foreign Capital Law*.

interest rate by the zero-profit condition for banks:

$$\bar{i} = \bar{r}. \tag{9}$$

Since we consider the case where domestic gross interest rates are in the range of (6), there is no flow of international funds in equilibrium. Moreover, the exchange rate is fixed, and the volumes of exports and imports for primary goods are determined by the balance of payments.

2.2 Effects of interest rate ceiling

In this subsection, we analyze the effects of interest rate ceiling. First, we derive the cost functions of manufacturing firms h and f. With respect to firm f, it minimizes its total cost $C_f = l + Rk$ subject to the production function in (3). The cost function of firm f is

$$C_f = a^{-1}\alpha^{-\alpha}(1-\alpha)^{-(1-\alpha)}R^{\alpha}x_f, \tag{10}$$

On the other hand, with respect to firm h, it minimizes its total cost $C_h = l + \bar{r}k$ subject to two constraints: the production function, (3), and the resource constraint from credit rationing, (8). Thus, we obtain the cost function of firm h as follows:

$$C_h = a^{\frac{-1}{1-\alpha}}x_h^{\frac{1}{1-\alpha}} + \bar{r}. \tag{11}$$

Since the capital input is fixed by credit rationing, (11) has the same form as the short-run Cobb-Douglas cost function. From (11), since $\frac{\partial C_h}{\partial \bar{r}} = 1$, the decrease in the interest rate ceiling reduces the total cost of firm h. However, since $\frac{\partial^2 C_h}{\partial x_h \partial \bar{r}} = 0$, we find that the interest rate ceiling does not change the marginal cost of firm h.

The profits of firms h and f are $\pi_h = P_x x_h - C_h$ and $\pi_f = P_x x_f - C_f$, respectively. The first-order conditions for profit maximization are

$$P_x' x_h + P_x - a^{\frac{-1}{1-\alpha}}(1-\alpha)^{-1}x_h^{\frac{\alpha}{1-\alpha}} = 0, \tag{12}$$

$$P_x' x_f + P_x - a^{-1}\alpha^{-\alpha}(1-\alpha)^{-(1-\alpha)}R^{\alpha} = 0. \tag{13}$$

Solving (12) and (13) yields the outputs and profits. By total differentiation of (12) and (13) with respect to $\bar{r}$, we have

$$\begin{pmatrix} D_{hh} & D_{hf} \\ D_{fh} & D_{ff} \end{pmatrix} \begin{pmatrix} \frac{\partial x_h}{\partial \bar{r}} \\ \frac{\partial x_f}{\partial \bar{r}} \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}.$$

We assume that $D_{ij} = P''_x x_i + P'_x < 0$ and $D_{ii} = P''_x x_i + 2P'_x < 0$ for the stability conditions of Cournot competition $(i, j = h, f)$. In this case, we find that $\frac{\partial x_h}{\partial \bar{r}} = 0$ and $\frac{\partial x_f}{\partial \bar{r}} = 0$. That is, the interest rate ceiling has no effect on the market share in Cournot duopoly because the policy does not change the marginal cost. Thus, the interest rate ceiling does not change exports.

Next, we consider the effect of the interest rate ceiling on national income. In this model, the wage income earned by young households is one. Old households accrue the dividend from firm h, $\bar{\pi}_h$, and income from deposit interest $\bar{i} - 1$ because $\bar{i}$ is the gross interest rate. Therefore, national income in period t is $\bar{i} + \bar{\pi}_h$, which equals expenditure in the old period as (1). Since $\frac{\partial \pi_h}{\partial \bar{r}} = -1$, this policy increases the profit of firm h and the household income derived from dividends because it reduces the fixed capital cost. On the other hand, from (9) we have $\frac{\partial \bar{i}}{\partial \bar{r}} = 1$. This implies that the interest rate ceiling on the lending market reduces the deposit interest rate. From (1), national income remains unchanged when the interest rate ceiling policy is implemented. Furthermore, since the policy does not change the price of the manufacturing good, welfare remains unaltered. The above results are summarized as the following proposition.

Proposition 1 *The simple interest rate ceiling does not change exports, and thus, does not change national income and welfare.*

Proposition 1 illustrates a consequence induced by credit rationing. From (4), a reduction in the lending interest rate leads to an increase in capital demand from firm h. However, because the decrease of the lending interest rate reduces the deposit interest rate through the zero-profit condition of banks, households' savings (*i.e.*, capital supply) is constant. Credit rationing leads to a new resource constraint for firm h as (8). Therefore, the simple interest rate ceiling does not change the marginal cost for firm h owing to the shortage of available capital.

3 Artificially low interest rate

In this section, we examine whether the artificially low interest rate, which is the combination of interest rate ceiling and a rationing rule, can improve national income and welfare. We extend the model for this purpose.

3.1 The extended model

We introduce an extra production sector, called the service sector, into our model. Firms in the service sector only supply their services to a perfectly competitive domestic market. The preferences of households are rewritten as

$$U^t = \eta_X \log X^{t+1} + \eta_y \log y^{t+1} + \eta_z \log z^{t+1}, \tag{14}$$

where z is the consumption of services, η_z is a positive constant, and $\eta_X + \eta_y + \eta_z = 1$. From (1) and (14), the demand for services is

$$z = \frac{\eta_z(i + \pi_h)}{P_z}, \tag{15}$$

where P_z is the price of services.

Next, we reconsider the financial sector and the relevant regulations. As in the previous section, the interest rate ceiling leads to excess demand in the lending market. Suppose the government establishes a rationing rule that orders all banks to lend funds advantageously to the manufacturing sector. That is, all banks must lend a certain fraction of their funds to firm h in order to satisfy the capital demand of firm h ,(4), at $r = \bar{r}$. Once the manufacturing sector has obtained sufficient funds, banks can lend the remaining funds to the service sector at another interest rate r_z. We assume $r_z \in [\max\{R - \tau, 1\}, R + \tau]$. Therefore, the amount of capital available (capital supply) in the service sector, $S_z(\bar{r})$, is determined as a residual of the savings from the capital demand of the manufacturing sector in (4). Therefore, the capital supply for the service sector is

$$S_z(\bar{r}) = 1 - k_h(\bar{r}). \tag{16}$$

Under these regulations, the lending market will be segmented: for firm h and for the service sector. Hence the lending rates may differ between the two sectors.

The production function of the service sector is also a Cobb-Douglas form: $z = bk^{\beta}l^{1-\beta}$, where $\beta \in (0, 1)$ and b is a positive constant. From the cost minimization problem, we have the cost function C_z and the capital demand function k_z:

$$C_z = b^{-1}\beta^{-\beta}(1 - \beta)^{-(1-\beta)}r_z^{\beta}z, \tag{17}$$

$$k_z = b^{-1}\beta^{1-\beta}(1 - \beta)^{-(1-\beta)}r_z^{-(1-\beta)}z. \tag{18}$$

Note that the service sector does not face credit rationing because the government does not regulate the lending interest rate to the service sector, and r_z is decided by the lending market equilibrium condition.

Since this sector is perfectly competitive, yhr price equals marginal cost. From (17), we have the horizontal supply curve for services as

$$P_z = b^{-1}\beta^{-\beta}(1-\beta)^{-(1-\beta)}r_z^{\beta}. \tag{19}$$

Therefore, from (15) and (19), the equilibrium volume of services is

$$z = \frac{\eta_z(i+\pi_h)}{b^{-1}\beta^{-\beta}(1-\beta)^{-(1-\beta)}r_z^{\beta}}. \tag{20}$$

When government implements the artificially low interest rate, the market equilibrium condition of lending funds for the service sector is $\bar{k}_z = \bar{S}_z$. Therefore, (4), (16), (18), and (20) yield the lending interest rate as follows:

$$\bar{r}_z = \frac{\beta\eta_z\left[\bar{i}+\pi_h(\bar{r})\right]}{1-k_h(\bar{r})} = \frac{\beta\eta_z\left[\bar{i}+\pi_h(\bar{r})\right]}{1-a^{-1}\alpha^{1-\alpha}(1-\alpha)^{-(1-\alpha)}\bar{r}^{-(1-\alpha)}x_h(\bar{r})}. \tag{21}$$

The deposit interest rate $\bar{i}$ is decided by the zero-profit condition for banks. Banks have two loan outlets: the manufacturing sector and the service sector. The lending revenue for the manufacturing sector and the service sector are $\bar{r}k_h(\bar{r})$ and $\bar{r}_z(1-k_h(\bar{r}))$, respectively. By the rationing rule, banks must preferentially lend funds to the manufacturing sector at the ceiling level; they can then lend residual funds to the service sector. Therefore, from (16), the zero-profit condition of banks is given by

$$\bar{i} = \bar{r}k_h(\bar{r}) + \bar{r}_z(1-k_h(\bar{r})). \tag{22}$$

3.2 Effects of the artificially low interest rate

We now consider the effect of an artificially low interest rate policy. First, we focus on the effects in the manufacturing sector. By the rationing rule, the artificially low interest rate policy is just a policy for this sector that reduces the lending interest rate without causing credit rationing. Therefore, by minimizing $C_h = l + \bar{r}k$ subject to (3), the cost function of firm h becomes $C_h = a^{-1}\alpha^{-\alpha}(1-\alpha)^{-(1-\alpha)}\bar{r}^{\alpha}x_h$, and the policy decreases the marginal cost; $\frac{\partial^2 C_h}{\partial x_h \partial \bar{r}} = a^{-1}\alpha^{1-\alpha}(1-\alpha)^{-(1-\alpha)}\bar{r}^{\alpha-1} > 0$. The first-order condition for profit maximization by firm h is

$$P_x'x_h + P_x - a^{-1}\alpha^{-\alpha}(1-\alpha)^{-(1-\alpha)}\bar{r}^{\alpha} = 0. \tag{23}$$

From (23) and (13), we have the following result.

Proposition 2 *An artificially low interest rate policy increases the output and profit of firm h, i.e.,* $\frac{\partial x_h}{\partial \bar{r}} < 0$ *and* $\frac{\partial \pi_h}{\partial \bar{r}} < 0$.

Proof. Total differentiation of (23) and (13) with respect to $\bar{r}$ yields

$$\begin{pmatrix} D_{hh} & D_{hf} \\ D_{fh} & D_{ff} \end{pmatrix} \begin{pmatrix} \frac{\partial x_h}{\partial \bar{r}} \\ \frac{\partial x_f}{\partial \bar{r}} \end{pmatrix} = \begin{pmatrix} a^{-1}\alpha^{1-\alpha}(1-\alpha)^{-(1-\alpha)}\bar{r}^{\alpha-1} \\ 0 \end{pmatrix}.$$

Solving this, we have

$$\frac{\partial x_h}{\partial \bar{r}} = \frac{a^{-1}\alpha^{1-\alpha}(1-\alpha)^{-(1-\alpha)}\bar{r}^{\alpha-1}D_{ff}}{|D|} < 0, \tag{24}$$

$$\frac{\partial x_f}{\partial \bar{r}} = -\frac{a^{-1}\alpha^{1-\alpha}(1-\alpha)^{-(1-\alpha)}\bar{r}^{\alpha-1}D_{fh}}{|D|} > 0, \tag{25}$$

where $|D| = D_{hh}D_{ff} - D_{hf}D_{fh} > 0$. Furthermore, differentiating the profit of firm h with respect to $\bar{r}$, we have $\frac{\partial \pi_h}{\partial \bar{r}} = \frac{\partial \pi_h}{\partial x_f}\frac{\partial x_f}{\partial \bar{r}} - a^{-1}\left(\frac{\alpha}{1-\alpha}\right)^{1-\alpha} r^{\alpha-1}x_h < 0$. ■

Proposition 2 implies that the artificially low interest rate has similar effects on subsidy policies. That is, the government concentrates the capital with low interest rate on the export sector without causing credit rationing. The policy reduces marginal cost of the domestic firm and increases its share on the world market under imperfect competition. This result illustrates a rent-shifting effect (Brander and Spencer 1985). It is widely known that subsidies can increase the market share of domestic firms, and furthermore, increase domestic welfare under imperfect competition. Generally speaking, however, it is difficult for developing and middle-developed countries to implement such subsidy policies because of the government's budget constraint. It is often noted that the opportunity costs of government spending in these countries are high (Brander, 1995) because the government has a number of problems to solve, for example, poor infrastructure, education, and medical services. The artificially low interest rate can also increase the market share of domestic firms. Note that, however, the rigid restriction on foreign exchange is necessary for the artificially low interest rate to be effective. The details of this point will be discussed in section 4.

Next, we consider the effect of an artificially low interest rate on the deposit interest rate. From (16) and (21), the revenue of banks for lending to the service sector is $\bar{r_z}S_z(\bar{r}) = \beta\eta_z(\bar{i} + \pi_h)$, which does not depend on $\bar{r_z}$. The increase in $\bar{r_z}$ has two effects on banks' revenue. It raises the interest

yield per unit of funds and reduces capital demand from the service sector. However, these opposing effects are nullified because of the Cobb-Douglas production function of the service sector. Thus, from (4) and (22), we have

$$\bar{i} = \frac{1}{1-\beta\eta_z}\left[a^{-1}\alpha^{1-\alpha}(1-\alpha)^{-(1-\alpha)}\bar{r}^{\alpha}x_h(\bar{r}) + \beta\eta_z\pi_h(\bar{r})\right]. \tag{26}$$

Note that $\bar{r}$ is a political parameter that is decided by the government. From (26), we obtain

$$\begin{aligned}\frac{\partial\bar{i}}{\partial\bar{r}} &= \frac{1}{1-\beta\eta_z}\left[\alpha A\bar{r}^{\alpha-1}x_h(\bar{r}) + A\bar{r}^{\alpha}\frac{\partial\bar{x}_h}{\partial\bar{r}} + \beta\eta_z\frac{\partial\bar{\pi}_h}{\partial\bar{r}}\right] \\ &= \frac{1}{1-\beta\eta_z}\left[A\bar{r}^{\alpha-1}x_h(\bar{r})(\alpha-\varepsilon) + \beta\eta_z\frac{\partial\bar{\pi}_h}{\partial\bar{r}}\right],\end{aligned} \tag{27}$$

where $A \equiv a^{-1}\alpha^{1-\alpha}(1-\alpha)^{-(1-\alpha)}$ and $\varepsilon \equiv -\frac{\bar{r}}{\bar{x}_h}\frac{\partial\bar{x}_h}{\partial\bar{r}} > 0$. From the first equality of (27), we find that a decrease in $\bar{r}$ has three effects on the deposit interest rate. The first term represents the reduction in banking profits earned from the manufacturing sector. This effect drives down the deposit interest rate through the zero-profit condition of banks, and is positive. The second term denotes the increase in capital demand from the manufacturing sector as a result of expansion in production (proposition 2). This effect raises the deposit interest rate, and is negative. Furthermore, from proposition 2, the artificially low interest rate increases the profit of firm h. From (1), this raises the income of households, demand for services from (15), and then capital demand from the service sector from (18). The third term represents this effect and is negative. A large value of ε implies that the interest rate ceiling improves the competitiveness of firm h and increases its capital demand. If $\alpha < \varepsilon$, the second effect dominates the first effect and the right-hand side of (27) is negative.[7] We have the following proposition.

Proposition 3 *If $\alpha < \varepsilon$, an artificially low interest rate policy increases the deposit interest rate, i.e., $\frac{\partial\bar{i}}{\partial\bar{r}} < 0$.*

[7] If we assume that household preferences are identical across regions and the first term in (14) has a Cobb-Douglas form such as $\eta_X \log X \equiv \sum_{n=1}^{N}\eta_{xn}\log x_n$, the inverse demand function for x_1 is $P_x = \frac{\eta_{x1}I_W}{x_h+x_f}$, where I_W is the total world income, which is constant under the small country assumption. In this case, from the definition of ε and (24), the condition $\alpha < \varepsilon$ is rewritten as $P_x < 2a^{-1}\alpha^{-\alpha}(1-\alpha)^{-(1-\alpha)}\bar{r}^{\alpha}$. This implies that the equilibrium price is no greater than the double average cost (or marginal cost) of firm h. Therefore, this condition is not extreme.

Next, we consider national income. Propositions 2 and 3 directly yield the following result.

Proposition 4 *If $\alpha < \varepsilon$, an artificially low interest rate policy increases national income, i.e., $\frac{\partial \bar{I}}{\partial \bar{r}} = \frac{\partial \bar{i}}{\partial \bar{r}} + \frac{\partial \bar{\pi}_h}{\partial \bar{r}} < 0$.*

This result claims that, if the interest rate ceiling sufficiently enhances the competitiveness of firm h, the policy raises the interest income of households as well as the dividend income from firm h.

At the end of this subsection, we focus on the service sector. First, we consider the lending interest rate for the service sector. If $\alpha < \varepsilon$ is satisfied, from (21), we have

$$\frac{\partial \bar{r}_z}{\partial \bar{r}} = \frac{\bar{r}_z}{\bar{i} + \bar{\pi}_h} \left[\frac{\partial \bar{I}}{\partial \bar{r}} + \frac{A \bar{r}_z}{\beta \eta_z \bar{r}^{(1-\alpha)}} \left(-\frac{(1-\alpha)\bar{x}_h}{\bar{r}} + \frac{\partial \bar{x}_h}{\partial \bar{r}} \right) \right] < 0. \tag{28}$$

This is an intuitive result. The artificially low interest rate increases the lending interest rate for the service sector. Next, we consider the price of service. Since the supply curve is horizontal, from (19) and (28), we have

$$\frac{\partial \bar{P}_z}{\partial \bar{r}} = b^{-1} \left(\frac{\beta}{1-\beta} \right)^{1-\beta} \bar{r}_z^{\beta-1} \frac{\partial \bar{r}_z}{\partial \bar{r}} < 0. \tag{29}$$

Thus, we find that the artificially low interest rate raises the price of service. Finally, let us consider the amount of service. By differentiating (15) with respect to $\bar{r}$, we have

$$\frac{\partial \bar{z}}{\partial \bar{r}} = \frac{\eta_z}{\bar{P}_z} \frac{\partial \bar{I}}{\partial \bar{r}} - \frac{\eta_z \bar{I}}{(\bar{P}_z)^2} \frac{\partial \bar{P}_z}{\partial \bar{r}} \tag{30}$$

The first term of (30) represents the effect for demand; the increase in income raises the demand for services, and this term is negative. The second term is the supply side effect; from (29), the interest rate ceiling increases the price, and this term is positive. From (21), (28), (29), and (30), we have

$$\frac{\partial \bar{z}}{\partial \bar{r}} = \frac{\eta_z}{\bar{P}_z} \left[(1-\beta) \frac{\partial \bar{I}}{\partial \bar{r}} + \beta \frac{\bar{I} A \bar{r}^{-(1-\alpha)} \left(\frac{1-\alpha}{\bar{r}} - \frac{\partial \bar{\pi}_h}{\partial \bar{r}} \right)}{1 - A \bar{r}^{-(1-\alpha)} \bar{x}_h} \right]. \tag{31}$$

Because $\beta \in (0,1)$, if β is sufficiently small, the first term dominates the second term in the bracket, and the policy increases the amount of services supplied. The above results are summarized as follows.

Proposition 5 *Suppose $\alpha < \varepsilon$. An artificially low interest rate policy increases the lending rate for the service sector and the price of services. Furthermore, if the service sector is sufficiently labor-intensive (i.e., β is small), this policy increases the amount of services.*

The artificially low interesting policy not only reduces the lending interest rate for the manufacturing sector but also concentrates funds into this sector. Thus, this policy reduces the funds available for the service sector. Hence, this policy raises the lending interest rate for the service sector as in(28), and then marginal cost and price of the service rises as in (29). On the other hand, from proposition 4, since this policy improves national income, the policy increases the demand for service. Therefore, the effect on the amount of service is ambiguous. The increase in the interest rate leads to substitution from capital to labor. Therefore, proposition 5 implies that, if the service sector is sufficiently labor-intensive, the expansion of the demand dominates the rise of marginal cost; there is a possibility that the amount of service increases under the artificially low interest rate policy.

3.3 Welfare analysis

Here, we consider the welfare effects of an artificially low interest rate policy. Since the utility function is separable from (14), we consider each term separately. Throughout this subsection, we assume that $\alpha < \varepsilon$, *i.e.*, an artificially low interest rate increases national income from proposition 4.

First, we rewrite the first term of (14) in an indirect utility form:

$$\eta_X \log X \equiv \eta_X V_X(\bar{i} + \bar{\pi}_h, P_{x1}; P_{x2}, \cdots, P_{xN}). \tag{32}$$

Since we suppose that the home country, which is a small country, does not have manufacturing firms with an index $n = 2, \cdots, N$, the prices of these manufacturing goods, $P_{x2}, \cdots, P_{xN}$, are exogenous parameters. From (24) and (25), we have $\frac{\partial X_1}{\partial \bar{r}} < 0$, where $X_1 = x_h + x_f$. Since $P_x'(X_1) < 0$, decreasing $\bar{r}$ increases the quantity and decreases the price of this manufacturing good. Therefore, the policy raises the indirect utility derived from the manufacturing good.

The third term of (14) is the utility from services. From proposition 5, if the service sector is sufficiently labor-intensive, the policy increases the volume of services and then, the household utility. The second term is the primary good. In our model, the price remains one. Thus, the increase in income raises the utility derived from this good. The above results are summarized as follows.

Proposition 6 *Suppose $\alpha < \varepsilon$. If the service sector is sufficiently labor-intensive (i.e., β is small), an artificially low interest rate policy always improves welfare.*

4 Discussions

In this section, we discuss the restriction on foreign exchange. Consider an extreme case of *free capital movement*, in which there is no transaction cost associated with international financial transactions. In this case, the service sector can borrow funds from the rest of the world with no transaction costs, and the lending rate for the service sector equals the world interest rate R. In addition, because banks can borrow funds from the rest of the world at a negligible cost, the deposit interest rate also equals the world interest rate. Moreover, in this case, the government cannot implement a low interest rate policy because banks will incur losses when the lending rate for firm h is decreased to the interest rate ceiling. Therefore, assuming some restriction on foreign exchange is necessary to obtain the results of the previous sections. Alternatively, we have assumed that all domestic interest rates are in the range given by (6). This simplification implies that no agent conducts financial transactions overseas. Clearly, this is also an extreme case. In order to adopt the artificially low interest rate policy, it is sufficient to allow domestic interest rates to diverge from the world interest rate. Thus, the propositions of the previous sections should hold as long as some financial transaction cost exists and the flow of international funds is imperfect.

In the past, developing and middle-developed countries with interest-rate ceilings had broadly regulated financial activities, including foreign exchange. These regulations created some friction; that is, they increased the transaction costs and validated the policy. In the era of rapid economic growth in Japan, the *Foreign Exchange and Foreign Trade Control Law* and the *Foreign Capital Law* worked as such distortions. These laws were basically enacted to economize the use of persistently scarce foreign exchange, and might have been effective for the implementation of the interest rate ceiling. Therefore, interest rate ceilings must entail some other financial distortions in the economy.

Today, it is extremely difficult for developing countries to implement the artificially low interest rate policy. The East Asian countries that once implemented this policy have discontinued it. For example, in Japan, international fund flow was liberalized in principle in 1980 by a full-fledged revision

of the *Foreign Exchange and Foreign Trade Control Law.* Other East Asian countries phased out their financial regulations in the 1980s and 1990s. Recently, a global trend toward financial liberalization has been observed. As fund markets move toward an integrated world market, transaction costs in funds markets will decrease. Some friction on financial transactions is necessary for the interest rate ceiling to be effective. If a government considers an artificially interest rate policy, it needs to impose severe regulations on financial activities. Therefore, as a result of global financial liberalization, the environment where interest rate ceilings are effective may have already been lost.

5 Concluding remarks

We have investigated whether the interest rate ceiling increases exports, national income, and welfare. We prove that the simple interest rate ceiling causes credit rationing, and thus, it does not work as an export-promoting policy. Furthermore, it has no effect on the national income and welfare. In contrast, the artificially low interest rate, which is the interest rate ceiling with a rationing rule, reduces the marginal cost of domestic firms and increases the income of households. We also mention that both the restriction on foreign exchange and the rationing rule are necessary for the interest rate ceiling to work as an export-promoting policy. The artificially low interest rate policy must entail an all-round intervention in the financial systems by the government.

Some studies provide plausible explanations of the interest rate ceiling. Hellmann et al. (1997) consider a policy that imposes a ceiling for the deposit interest rate, while we investigate a policy that imposes a ceiling for the lending interest rate. They point out that the interest rate ceiling creates rent in the financial sector.[8] They argue that, by giving rents to financial intermediaries, the policy has a positive effect in reducing problems on information such as the monitoring of investment or the provision of deposit collection, which might be underprovided in a purely competitive market. Demetriades and Devereux (2000) present a model that has two financial markets: an official financial market and an alternative curb market. When the government implements the interest rate ceiling in the official financial market, the official financial market cannot satisfy capital demand from

[8] In their context, if the rent is deprived by the government, it leads to financial repression similar to McKinnon (1973) and Shaw (1973).

firms owing to credit rationing. However, since firms can borrow from the curb market with a high borrowing interest rate, there is a possibility that capital stock will be higher in the long-run equilibrium than the laissez-faire case. Daitoh (2003) investigates the effects of the low lending interest rate policy on urban unemployment using Harris-Todaro model. The policy leads to the reduction of savings and employment in the urban sector. However, this policy represses the rural-urban migration; it may decrease urban unemployment, increase agricultural output, and then improve welfare. This result implies that rapid financial liberalization may aggravate welfare in developing countries.

The above studies have analyzed this policy mainly from the perspective of economic and financial development. In contrast, we have focused on the effects of interest rate ceiling on exports, which have previously not been discussed in the literature. In our model, the artificially low interest rate policy provides aboundant supplies of cheap capital to the exportable manufacturing sector. This policy has a rent-shifting effect, and it improves the international competitiveness of the domestic firm as the subsidy policy shown by Brander and Spencer (1985). At the same time, however, the artificially low interest rate may lead to the same problem as subsidy policies do. That is, in perfectly competitive environments, this policy would lead to welfare loss. Moreover, there are some possibilities that this policy will induce additional inefficiencies, for example, a rent-seeking problem as lobbing activities or delaying R&D activities in the protected industries. Attempts to address these issues remain topics for further research.

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